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Date 24 June 1993

27th Annual DoD Cost Analysis Symposium (DODCAS)

Dear Mr Riddick

In response to the letter sent by Mr Scott of the US Army Cost & Economic Analysis Centre informing me that my proposed paper had been selected for presentation, I forward a copy of the paper. A second copy has been sent under separate cover to Mr Scott. If the Air Mail postal system works properly, I should just make the 30 June deadline.

I look forward to returning to the Xerox Centre and meeting with you in September and hopefully picking up with some of the American analysts with whom I have worked in the past.

In my covering letter to Mr Scott I have noted a presumption that an invitation and accommodation booking form will be sent to me in due course so that I can make my travel arrangements. I will extend to you the same invitation as made to Mr Scott that you should not hesitate to contact me in writing or by telephone in the event of any difficulties. My answering machine will take care of messages in my absence due to time differences, but the Fax line may not be so accommodating.

Yours faithfully

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ABSTRACT

USING ACTIVITY COSTS AS BUILDING BLOCKS TO ESTIMATE OVERHEADS IN A CHANGING BUSINESS ENVIRONMENT

As nations alter defence requirements to reflect the changing world order, procurement agencies need a better understanding of the cost implications as industry redefines its strategy and examines its options to meet future business patterns. Emphasis has been increased on the need for better management and more accurate estimation of overhead costs, much of which is people related.

This paper describes two separate but similar techniques - COURSE and SOURCE - which provide a standard approach to the analysis of personnel by function and indicate cost drivers and factors which influence manning requirements.

A company functional model has been derived from the analysis of results from these techniques from companies in various defence sectors and ranging in size between approximately 100 and 27000. Analyses of skills mix requirements and control span ratios have been added. The system is readily adaptable to computer processing and Monte Carlo simulation. This would allow both industry and procurement agencies to generate iterative overheads cost forecasts against alternative business strategies of use by management and in policy decision making.

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USING ACTIVITY COSTS AS BUILDING BLOCKS TO ESTIMATE OVERHEADS IN A CHANGING BUSINESS ENVIRONMENT

INTRODUCTION

As nations alter defence requirements to reflect the changing world order, procurement agencies need a better understanding of the cost implications as industry refines its strategy and examines its options to meet future business patterns. The demand for change has been relatively sudden and is of a much more long term nature than that caused by the oil crises of the 1970s. Anticipated savings, the so-called "peace dividend", cannot be achieved overnight and may yet be several years down-stream due to the effects of product life cycles. Figures 1 and 2, drawn to the same timescale, indicate potential differences which might be experienced by a predominantly defence contractor and one in the more commercial or consumer market. Increasing emphasis and interest is being placed by government procurement agencies on the need to estimate and control costs, especially overheads. This scrutiny is being reflected by industrial management, with the additional implications for higher earnings and stockholder returns.

Industry's responses to the contraction of defence business has been slowly evolving, the immediate need being forestalled in many instances by continuing "cold war" order books and the need to replace equipment following the Gulf conflict. There are signs that this period of respite is coming to a close as some companies announce the closure or sale of their defence sector businesses, or form close alliances and mergers. Each of these activities brings with it the need to re-structure, rationalise or create new business entities. In addition, changes brought about by the continuing use of computers and the adoption of such business practices as "Just-in-time" (JIT) and Total Quality Management (TQM) are helping to enhance productivity and provide increasing value for money for the customer. It is against this general background of continuing change that this paper has been researched and presented.

It is assumed that the industrial and technical workload determines the scale and scope of that part of the workforce who traditionally record their time directly to contract. Emphasis in this paper is focussed on the indirect or overheads cost structure. A high proportion - approximately 70% - of these costs are people related. An understanding of the number, skills and supporting systems used by personnel in the various overheads areas can prove a good starting point for seeking improved performance at potentially lower cost. The concept of costing activities to demonstrate that value is being added at all stages becomes the natural follow-on consideration. I make no apolgies therefore in introducing an alternative perspective on Activity Based Costing (ABC) and could have sub-titled this paper "ABC - A British Consideration".

The core of this paper is the introduction of a standard analytical approach through two separate but similar techniques

COURSE and SOURCE to assess the effects of manufacturing and development engineering respectively.

COURSE AND SOURCE - ANALYTICAL TOOLS FOR ACTIVITY BASED COSTING

If activity based costing is to have credibility, it would be appropriate for company and Government officials to have a common understanding of the company's corporate objectives and the ways in which it deploys its assets and resources to achieve those objectives. This is a particularly important concept, since personnel assets are the source of a high proportion of indirect or overhead costs. Their work will be determined in part by past activities of the company, in larger measure to supporting current business, whilst the remainder is aimed at securing future viability.

In order to understand how, where and why such human assets are deployed, two analytical tools are described. They provide a standardised analytical approach, suitable for companies of all sizes and in all industrial sectors. Their format is such as to permit easy use of computers for the purpose of analysing and comparing the data by company. The main purposes of these analytical tools are to provide:-

a) a basis for establishing manning levels within given activities, from which personnel related costs can be validated.

b) a means of gaining a thorough understanding of the company structure, organisation and management control systems.

c) a formalised basis for intra-company trend assessment over time or inter-company comparisons at a given point.

They should <u>not</u>, however, be seen or used as a mechanism by which redundancies can be created, although apparent weaknesses or inconsistencies should be thoroughly reviewed with management or at board level. Industry may. however, use the technique to ascertain the amount of value added by each activity. The use of these techniques should <u>not</u> be viewed simply as an exercise in ratio analysis, but rather their use in proper context.

The analyses rely not on the companys' descriptions of those activities which they regard as either direct or indirect for contract charging purposes, but rather on a standardised description between those who are classified as productive and the non-productive remainder. Under these conditions, the definition of a productive worker is one who:-

"Is specifically involved in changing the physical or confirming the performance characteristics of items during the process of moving from raw material to saleable product."

This description will therefore include test personnel (but not inspectors) as well as tool room operators, since product tooling can be "sold" as part of the contract price.

The primary whole company analysis format is COURSE or CORPORATE ORGANISATION, UTILISATION, RESOURCES and SYSTEMS EVALUATION. It takes its name from course, a mode of action, sequence of related events, progress or trends - indicating the direction in which the company intends to pursue its current and future objectives. A copy of the two part form is shown in Figs 3 and 4. It is based on company payroll data in the form of personnel names with departmental job titles. Where companies are part of a substantially larger group and particularly where they derive considerable support from other areas or headquarter offices, the nature of any inward charges, together with the personnel data to which they relate will need to be provided. Any hired personnel, whether on- or off-site will also need to be recorded. Similarly any long-term (over 3 months) absentees and part-time staff (with scheduled attendance hours) will need to be provided. This payroll data should be supported by a full set of comprehensive organisation structure charts.

The COURSE analysis form provides a matrix in which the rows provide details of major functional groups of activities, whilst the columns show the various levels of responsibility and skills from board directors down through the layers of management and the various professional, clerical and manual or craft skills, trainees and productive labour.

The functional groups cover:-

Executive	Those charged with the strategic direction of the company together with their support staff and the accounting function.
Commercial Services	Those responsible for all activities which secure and place contracts/sub-contracts and provide sales and estimating support.
Human Resources	Covers employment, welfare and training, security and canteen facilities.
Engineering Services	Covers design, drafting and development activities, including those relating to tooling and test equipment.
Production Services	Covers stores, production planning and control, workshop management and overall production administration and maintenance.
Quality Services	Quality management, audit and inspection.
Workshop Services	Toolroom and all productive facilities.

A typical company functional model is shown at Fig 5, with the various service areas structured in a form such that the lines of association can be clearly identified. These lines may be uni- or bi-directional, indicating that the functions have direct impact on manning levels or have a bearing on the creation of policy. This illustration will be returned to later.

The levels of responsibilities and skills are recorded under the following broad headings:-

A	Board of directors		
B	Management	B1	Departmental heads
		B2	Senior executives
		B3	Middle managers
C	Supervision	C1	Of specialists
		C2	Of engineers and scientists
		C3	Of administrators and clericals
		C4	Of crafts and trades
D	Specialists		Specialist or professional staff who are independent practitioners often with no supervisory functions.
E	Engineers/Scientists	E1	Design and drafting
		E2	Development and trials
		E3	Production support
		E4	General engineering
F	Administrators/Clerks	F1	Senior administrators/clerks
		F2	Routine administration/clerical
		F3	Office machinery operators
		F4	Expediters
		F5	Storekeepers
G	Non-productive trades	G1	Skilled maintenance
		G2	Semi- or unskilled maintenance
		G3	Inspection (skilled)
		G4	Semi-skilled examiners
H	Trainees	H1	Youth trainees/apprentices
		H2	Adult trainees
J	Productives	J1	Skilled workers
		J2	Semi-skilled workers
		J3	Unskilled workers

In order to provide a permanent record of the overall company structure, the bottom of the COURSE form sets out the various management control ratios derived from the column totals. These are:-

1	A	B1
2	B1	B2
3	B2	B3
4	B3	Sum of C1 to C4 inclusive
5	C1	D
6	C2	Sum of E1 to E4 inclusive
7	C3	Sum of F1 to F5 inclusive
8	C4	Sum of G1 to G5 plus J1 to J3 inclusive

Unless a separate training centre exists, trainees should be ascribed to the activities related to the departments in which they are working at the date point of the analysis. They should also be included with the skill groups with which they logically associate for the purpose of calculating the management control ratios at the C level. Within the more detailed understanding of the company structure, individual activity ratios for B2 : B3, B3 : C1 to C4 and the separate C levels can be considered in isolation, enabling the significance of any apparent anomolies to be identified and discussed. In this context, it should be recognised that the mix and levels of skills in any given activity, as well as the ability to make decisions, will have a strong influence on the span of control possible. Whilst a foreman could quite easily supervise a group of 16 to 20 productive workers, a Chief Executive would be more likely to sustain between 3 and 6 senior staff reporting directly to him.

Being a general purpose form, not all companies will have need for, and therefore entries in, each one of the activities or skills. For those that do, the following represent some but by no means an exhaustive list of the factors which will alter staffing numbers against each activity. Many will be the subject of company policy, the overall organisational structure or the type of business in which the company is operating.

Executive	Legal requirements, company size and relationship with any higher group structure.
Accounts	Legal requirements, company size, nature and volume of business, outside purchases and use of ADP facilities.
Commercial	Nature and volume of business, types of contracts, number of tenders responded to and success rate, use of past data for parametric estimates, extent of repeat work.
Procurement	Nature and volume of purchases of raw materials, proprietary parts and consumable stores and the use of sub-contractors to replace scarce or non-available facilities and expertise in-house. Essentiall driven by make or buy policy.
After-sales service	Product reliability/durability, servicing policy, location of products and whether they are primary (aero engines) or secondary (engine fuel pumps).
Human Resources	Employment legislation, size, location, staff turnover levels, employment contracts, training/career development, on-site dining, medical and recreational facilities.
Maintenance	Company policy on planned or remedial

	maintenance by own or hired labour, lease or ownership of facilities operated.
Production Co-ord	Nature and complexity of facilities and need for co-ordination of several production support functions.
Planning	Major factors will be nature and complexity of products, product mix and amount of repeat business. Amount of computerised planning, NC machinery/assembly devices and methods of job timing will also influence manning levels.
Production Control	Nature and complexity of products, product mix, lot sizes and make/buy policy, together with availability of shop floor progress data input terminals will determine manning requirements.
Stores	Nature and mix of products and production processes, number, size and location of stores, frequency of inventory control, the need for, and availability of mechanical handling aids on and off site.
Inspection/QA	Company policy on quality management, use of operator controls, sampling techniques, lot sizes and expected yield rates appropriate to the productive facilities to which this activity is directly related.
Workshops	These cover the traditional manufacturing activities, with separate reference to Tool Room, Repair & Overhaul and Packing.
Miscellaneous	This covers non-standard activities not found in the majority of companies, such as the Air Traffic Control function associated with an aircraft manufacturer's airfield.

Engineering Services cover all those activities which would be expected to support the design, development and proving of new products or the enhancement of the existing items. Although the staffing in this activity are shown on the one row allocated, a more detailed analysis can be undertaken on a separate format. This separate analsis is best performed when the number of scientists, engineers and technologists, together with their clerical and administreative support staff ascribed to this activity reaches 25% of total manning or a total of 400 within a larger organisation. It would be unusual to conduct an analysis of the Engineering Services activity without having first undertaken a whole company survey.

The Engineering Services analysis form is SOURCE or SYSTEMS, ORGANISATION, and UTILISATION of RESOURCES in CONCEPTUAL

ENGINEERING. It takes its name from source, a starting point, origin or work from which other ideas are derived - indicating the direction in which the company intends to support its current activities and secure its future viability. See Fig 6. The SOURCE form provides a matrix in which the rows show the engineering activities, whilst the columns contain the various management and skills levels which are common with the COURSE form. It only includes skills appropriate to the engineering function.

In common with the COURSE form, the SOURCE analysis does not rely on the company's description of those regarded as direct or indirect for contract charging purposes. It differentiates instead between those who regularly record their time (bookers) and the non-booking remainder. In the case of companies where almost all engineering related staff record their time either by the hour or day, this differentiation will not be important.

The variety of research, development, design, drafting and trials activities likely to be met throughout the various parts of the defence industrial sector may be as wide as the variety of products they produce. The situation is additionally complicated by the introduction of matrix management structures in which a project manager takes overall responsibility for all aspects of an individual programme or group of projects but does not necessarily enjoy full authority over the staff assigned to the project. Under these conditions, it is even more important that a comprehensive set of organisation charts accompany the payroll data. Standard activity headings have been included on the SOURCE form, but may not be an exhaustive listing. For full understanding of the company engineering/development department structure, space is available for additional activities to be added.

The control ratios remain common with the COURSE format. The foregoing remarks represent the most tedious and mechanical aspect of the task, although it is possible to write a program to collate coded entries and provide the necessary horizontal and vertical check sums required on the forms. At this stage, the more interesting aspects of the investigation can start. Having indicated that a high proportion of indirect or overhead costs are people related, these costs can be directly attributed to activities either through direct entry of pay data from the personnel/payroll listing or by wage/salary band averaging based on knowledge of local or national rates applicable to broad categories of skills.

At this stage, details of the company's total budget will be required, so that an accurate allocation of costs to activities can be prepared. Some costs will be readily identifiable to single activities, but others will be more difficult to identify. These latter will need to be discussed in some detail with those who are responsible for both providing and consuming them. This gives further scope and topics for the most important part of the analysis, the discussions with senior management and functional activity heads. The following remarks

indicate some of the areas in which such discussions can prove useful, and build on the previous notes concerning major cost drivers in each of the activities. They are therefore listed in the same order.

Executive — These discussions will need to be conducted with sensitivity and may well take the form of an initial briefing of the purpose of the analysis, coupled with their views of future prospects and company strategy to meet that challenge. They will also need to consider and discuss the analysis findings.

Accounts — Cost apportionment method and rationale will need to be explored in some depth, to get a baseline from which to determine if the costs are being correctly attributed. In this area, as in all subsequent areas which have budgetary responsibility, the analysis will need to consider how the budgets are set, the speed and accuracy of feed-back performance data and the amount of management flexibility to take corrective action.

Commercial — Aside from discussions on the nature of the company's business and their effect on its commercial activities, this function also provides sales and estimating services, telephones and internal mail distribution. Sales issues are best addressed through an understanding of market research, specific Government restrictions and nature/strength of national/international competition. Estimating aspects will depend on extent of use of historical data and shopfloor skills drift, productivity and operator learning.

Procurement — The analysis will need to focus on the sources of requests for external purchasing and the extent to which these are directly attributable to external sales. Analysis of indirect purchases and allocation to their respective functional activities will also be required. These discussions will also take account of any order control and buying progress systems which support the activity. Sub-contract issues will need to be addressed through an understanding of the rationale underpinning make or buy decisions and policy.

After-sales service — This activity relates specifically to work carried out away from the factory, such as at Government facilities or customers' premises and should not be confused with

Repair and Overhaul which is conducted on the company site. Outside staff often attract high levels of subsistence payment, travel costs, etc or will be based in their own off-site facilities which will attract their own running costs identifiable in the overall budget. The analysis should seek to ascertain whether any of these costs are offset against the direct charges for providing after-sales service off-site.

Human Resources

Apart from understanding how employment legislation affects this activity, the analysis will need to focus on the use of age/skill profiling and their relationship to the ongoing demands of the company. Success rates in recruitment and retention will need to be matched to the costs of advertising, interviewing and assisting the family removal of selected candidates. Some insight into the local labour market will be necessary to validate any make/buy decisions made on the basis of skills shortages. The views of functional managers should also be sought on labour turnover in their areas. Training and/or career development schemes should interlock with these requirements and some indication of post-training retention rates should be sought. Other welfare type activities will cover staffing for canteen and those necessary for physical security, including firefighting where appropriate.

Maintenance

The maintenance manager is often responsible for the utilities budget and the analysis will need to be supported by a site plan showing the disposition of facilities, full details of the extent of utilities metering to discrete areas of work, types of controls to ensure best use of electrical power and demonstration of adequate labour resources control. The remark about budgetary control, feedback and corrective action are very relevant in this area. The maintenance manager should also be able to produce a comprehensive plant/machine tool listing and demonstrate its applicability to both maintenance scheduling and periodic levels of utilisation for subsequent discussion with the appropriate workshop managers. If a separate maintenance store is operated, details of the control mechanisms will need to be ascertained.

Production Co-ord

This small group takes on a similar role in the production/manufacturing field as that

of Administration to the total company.

Planning — This activity covers work study, ratefixing, process planning and methods engineering in a comprehensive group aiming to balance the workload against available resources. There should be seen to be sufficient liaison with the maintenance and production control activities to ensure that this objective is met. Some staff in this activity may also be seconded to Engineering Services as Value Engineers or to ensure that the drawings are suitable for manufacture. Some measure of performance can be gained from the number of changes to planning documents resulting from changes to materials, methods, machine tools or design.

Production Control — This group is responsible for creating and monitoring the shop floor workload and for its timely movement from one operation to the next. Its work may rely heavily on the use of paperwork, the creation of which will be subject to scrutiny in any analysis. It will also react to any underlying quality trends and the needs to create stock for future consumption. Use of proprietory production control software and application of just-in-time manufacturing concepts to reduce lead times and work in progress costs should be discussed as part of the analysis.

Stores & Transport — Adequate utilisation of floor area/space is potentially of greater importance in this activity than many others. The analysis should consider the stock turnover ratio as this may give an indication of utilisation of facilities and personnel. Interest and insurance costs of stocks held in store should also be recognised. Other aspects to be considered include stock losses through breakage/pilferage/bad record keeping, stock obsolescence, the extent of incorrect issues or shortages from stores/kit marshalling. Substantial use of overtime in this service activity should also be recognised. Visual inspection as part of the analysis will confirm views on stores security, activity and utilisation levels. Internal/external transport will reflect requirements, lease or buy decisions and utilisation.

Inspection/QA — The analysis should examine the quality trends within functions and seek the reasons for them and what steps can be taken to effect improvement. An understanding of the

management quality philosophy will be important in forming a view on the efficient use of inspection equipment. The mechanisms for control and calibration of inspection equipment, gauges, etc., will also need to be examined.

Workshops — It will be useful during the analysis to visit each of the workshops, to form views on layout, utilisation, activity levels, amount of work in progress, tidiness and the general standard/condition of equipment. A confirmation of overall utilisation will be obtained from the comparison of direct or saleable productive hours from each workshop with the number of personnel employed in each.

Engineering Services can be considered in the same broad way as the worshops, ie by comparing the number of saleable hours from the activity with the number of staff who record their time and the recording system employed in terms of booking codes and the minimum time element recorded.

USE OF COURSE & SOURCE DATA FOR OVERHEAD ANALYSIS/ESTIMATING

As an introductory comment, it should be noted that a more detailed coding list has been created for the British industrial situation and differences in job titles may exist in America. It is anticipated that these differences can be fairly readily determined and remedied. Techniques similar to this have been applied successfully in the UK in highlighting weaknesses in overall approach and recommending appropriate alternatives for management consideration and implementation. Imperfections are inevitable in all companies, particularly where product mix and throughput vary significantly over time. There must also be an understanding by analysts of the extent to which staffing levels in individual activities reflect the demands of yesterday, today and provision for tomorrow. All companies are living entities, staffed by people, supported by systems and resources. Efficient use of those facilities is the objective of the analysis.

Its use as the medium for overheads estimating is the subject of the final part of this paper. A number of companies, varying in size between approximately 100 and 27000 have been analysed by industry within the defence sector. Four specific areas were readily apparent, namely aerospace, radars, general engineering, (primarily mechanical) and general electrical/electronics. Using the company functional model (Fig 5) referred to above, a series of parametric manning relationships were derived between functions and the productive workforce (including engineering staff where appropriate). These relationships are portrayed in a series typical of one of the industry categories in Fig 7. The format accords with the functional model for ease of study. The tolerance bands on the parametrics give an indication of the variability and complexities of modern business structures.

For the purposes of analysis it can be assumed that the productive workforce is directly related to the business volume and throughput capacity. Using step-by-step computations based on these identifiable manning levels, it is possible to derive the function and total indirect manning numbers. A typical example might be, for a company with 1000 workshop productives, the stores and transport function would total between 80 and 105 staff.

Behind this first stage analysis, further analysis provides a range of values for the skill mix between clerical, technical and manual crafts at the first line support stage - ie the first working level. This analysis is shown in Fig 8, which follows the standard format for easy reference. Tolerance bands have again been provided as a means of indicating the variable nature of industry and its use of particular skills mixes in the various functions according to its systems and position in the business cycle (Figs 1 and 2). Continuing with the example above would result in approximately 25 clerical and 75 manual craft workers. (total 100)

A third stage analysis, shown in Fig 9, shows the spans of management control above first line. In this instance the 1st Line span of control relates to the number of first line staff for whom a section leader, foreman, etc would be responsibile. These again are presented in the standard format so that for individual functions and for the complete company, a detailed hierarchical structure (by skills) can be drawn up. Following on with the analysis above, using a typical 13:1 1st Line span of control ratio would give 7 supervisors of whom 1 would be a middle manager to come within the 5:1 to 8:1 span of control at that level. This is demonstrated in Fig 10.

The final stage, which has not been demonstrated here, is to ascribe average wages and employment costs for each of the levels and categories of staff in the various functions in order to arrive at the pay bill for the indirect staff. Some areas, such as maintenance which manages the utilities budget and buys spare parts for plant and machinery, will need a material cost element adding if the total function costs are to be determined. All function costs can then be aggregated to arrive at total overhead operating costs. The data has been presented in such a way as to lend itself readily to computer processing and Monte Carlo simulation.

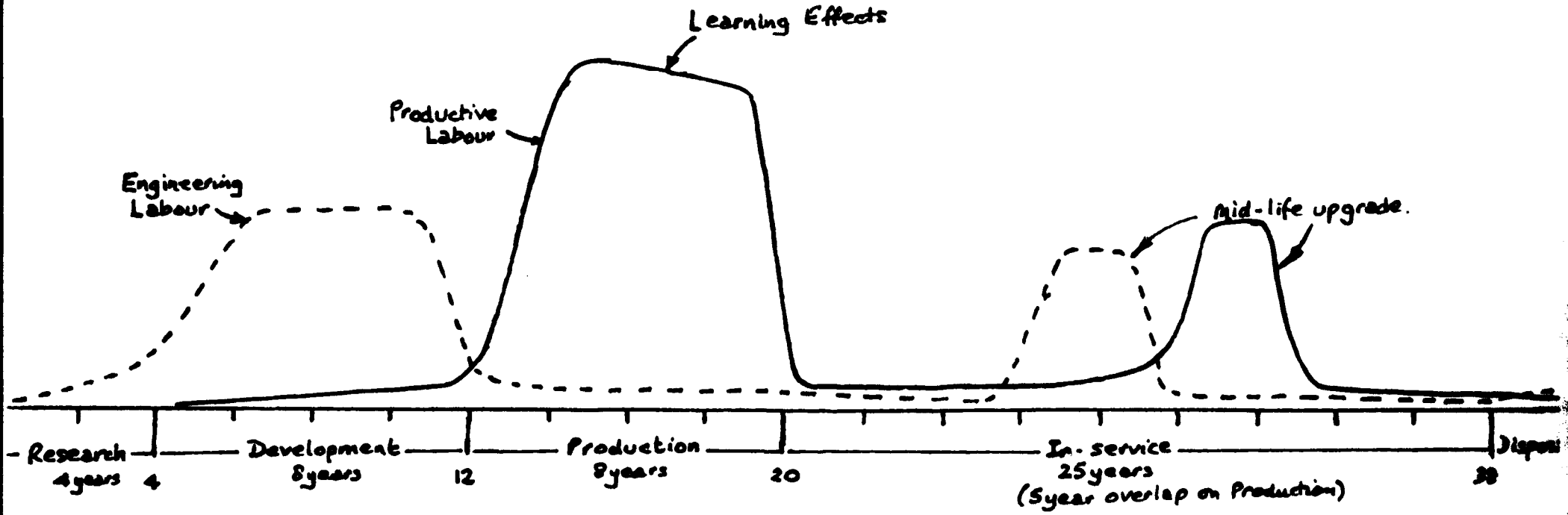
CONCLUSION

Trends in manning numbers by function and business sector, allied to skills mix and control span parametrics, and with the addition of material expenditure data, can be used to simulate the overhead costs at activity and company levels.

A V G Deller

Typical Product Life Cycle Manning Demands

Defence Equipment



TYPICAL PRODUCT LIFE CYCLE MANNING DEMANDS

CONSUMER PRODUCTS
(to same scale)

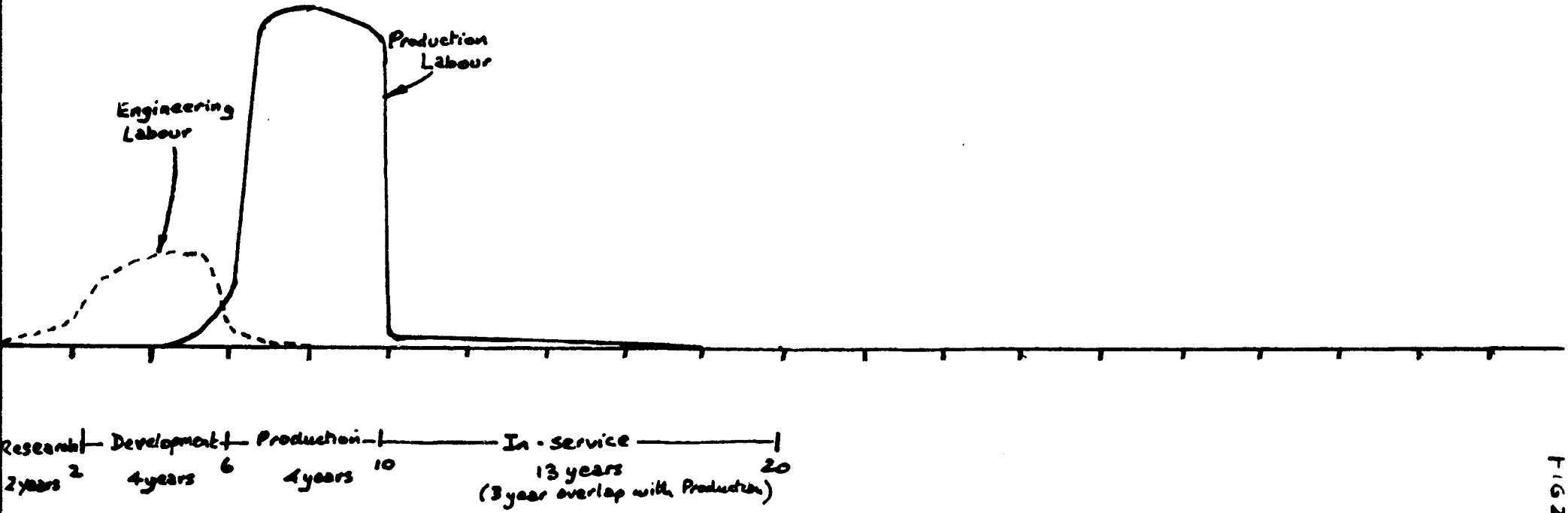


FIG 2

F103

COURSE DATA FILE
COMPANY LOCATION DATE

SKILL LEVEL / ACTIVITY	A	B1	B2	B3	C1	C2	C3	C4	TOTAL C	D	E1	E2	E3	E4	TOTAL E
ADMINISTRATION															
ACCOUNTS															
COMMERCIAL & SALES															
BUYING & SUB-CONTRACTS															
HUMAN RESOURCES															
MAINTENANCE															
PRODUCTION CO-ORD															
PRODUCTION PLANNING															
PRODUCTION CONTROL															
STORES & TRANSPORT															
QA/INSPECT MANAGEMENT															
TOOLROOM INSPECTION															
PROCESSES INSPECTION															
FOUNDRY/FORGE INSPECTION															
MACHINE SHOP INSPECTION															
DETAILS/FITTINGS INSPECT															
ASSEMBLY INSPECTION															
TEST INSPECTION															
STORES/GOODS IN INSPECTION															
TOOLROOM															
PROCESSES WORKSHOP															
FOUNDRY & FORGE															
MACHINE SHOP															
DETAILS/FITTINGS SHOP															
REPAIR/OVERHAUL SHOP															
ASSEMBLY WORKSHOP															
TEST FACILITIES															
PACKING & DESPATCH															
AFTER-SALES SERVICE															
PROTOTYPE/MODEL SHOP															
ENGINEERING SERVICES															
MISCELLANEOUS															
TOTAL MANNING															
CONTROL RATIOS	1	2	3	1	5	6	7	8							

FIG 4

COURSE DATA FILE

COMPANY LOCATION DATE

F1	F2	F3	F4	F5	TOTAL F	G1	G2	G3	G4	G5	TOTAL G	H1	H2	TOTAL N-PROD	J1	J2	J3

NON-PROD:PROD RATIO

A Company Functional Model

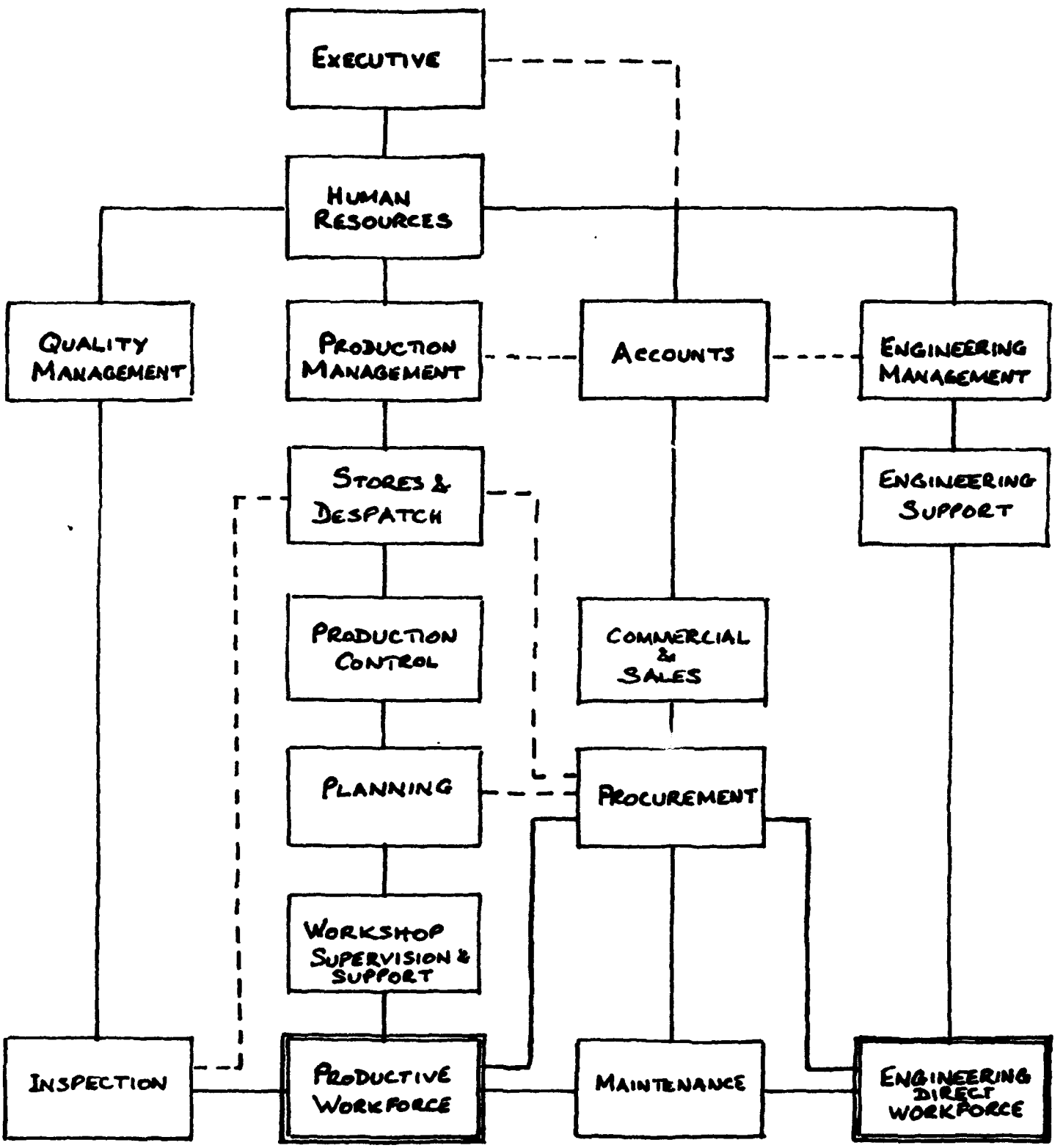
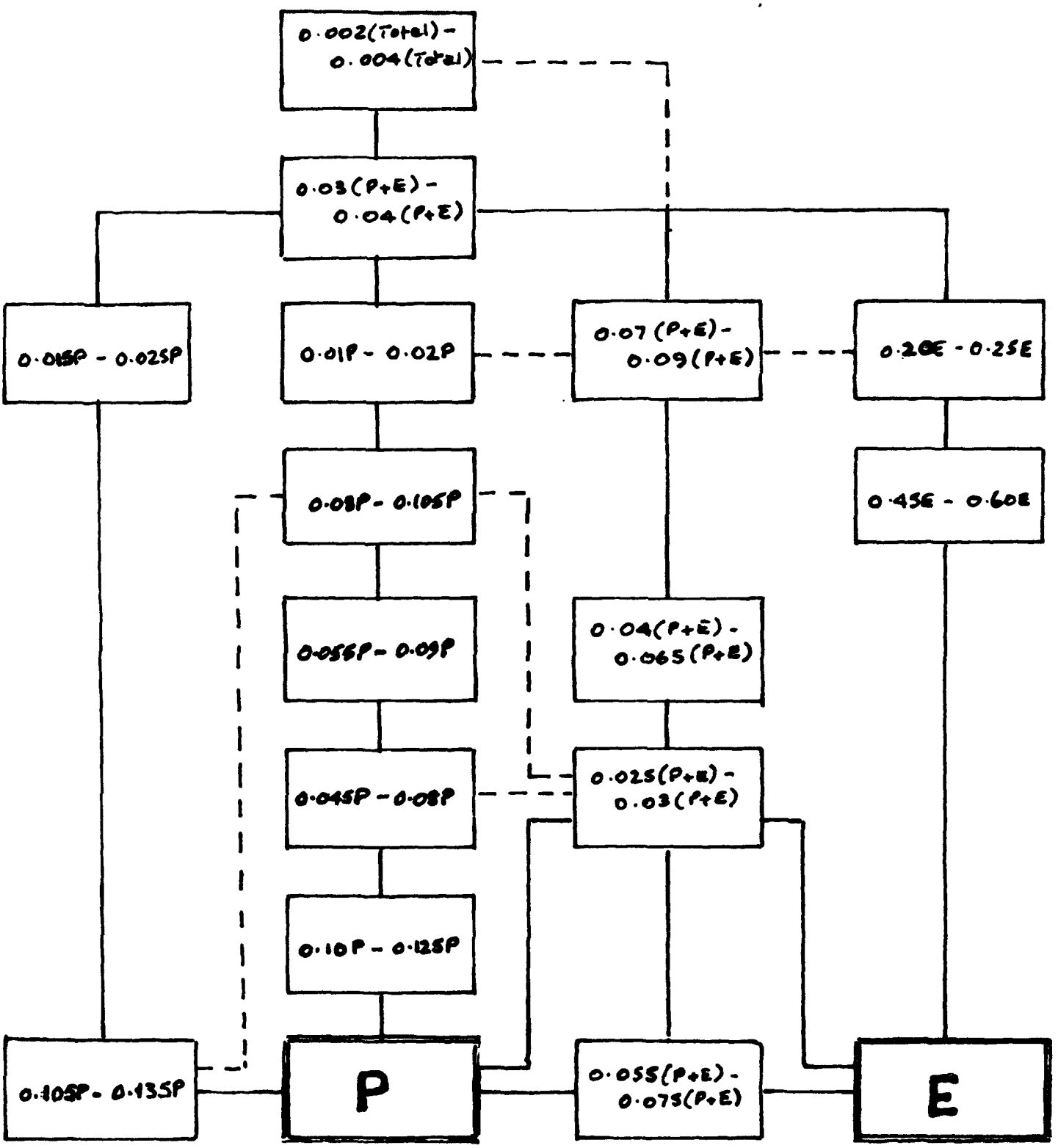


FIG 6

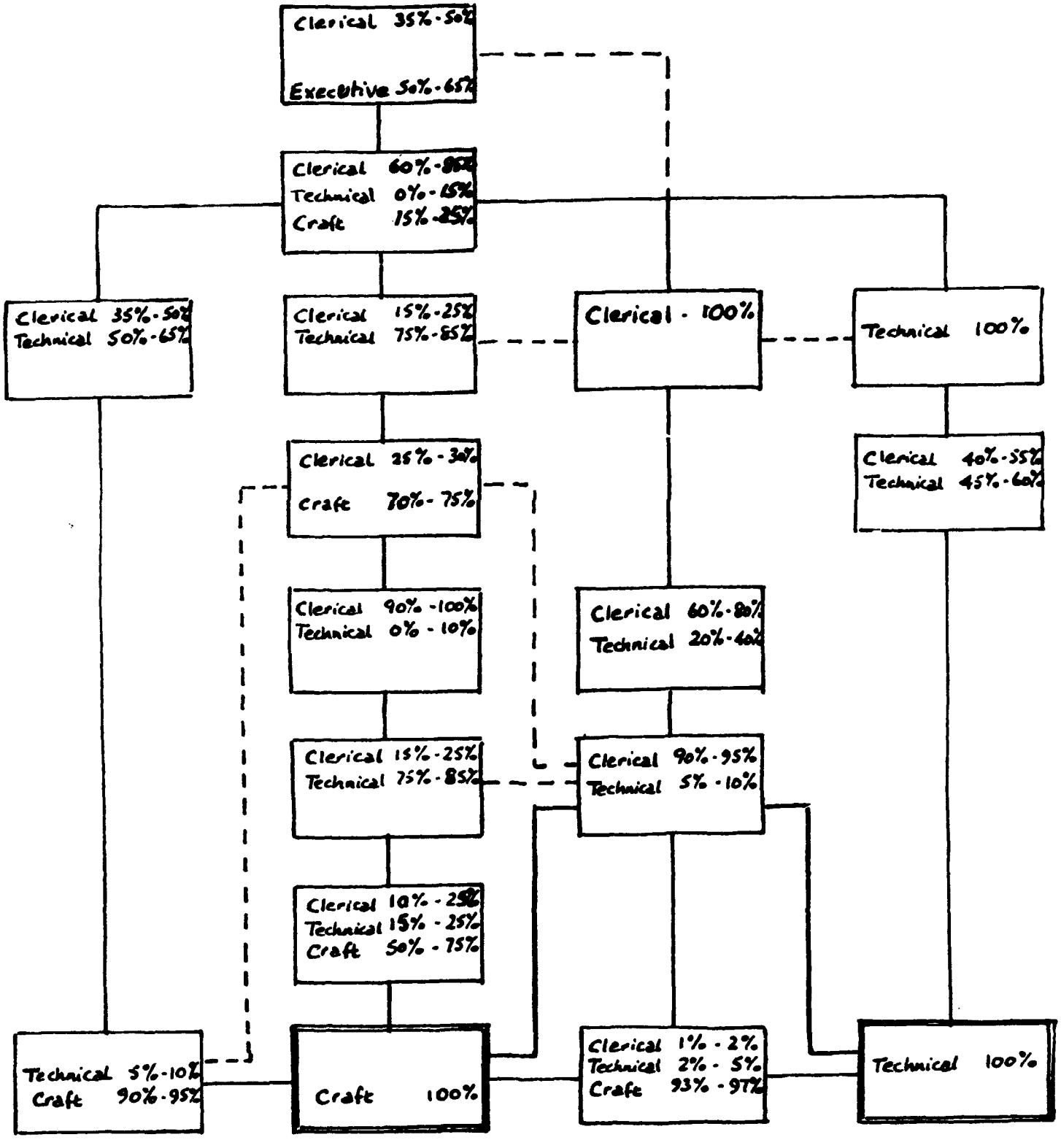
SOURCE DATA FILE
COMPANY LOCATION DATE

ACTIVITY / SKILL LEVEL	B1	B2	B3	C1	C2	C3	TOTAL C	D	E1	E2	E3	E4	TOTAL E	F1	F2	F3	F4	F5	TOTAL F	TOTAL BOOKERS	TOTAL N-BOOK
ENGINEERING MANAGEMENT																					
PROJECT MANAGEMENT																					
DEVELOPMENT PLANNING/PERT																					
PURE/APPLIED RESEARCH																					
APPLICATIONS																					
MATERIALS/PROCESSES																					
DESIGN STANDARDS																					
DESIGN ASSURANCE																					
DESIGN																					
DRAWING OFFICE																					
COMPUTER AIDED DESIGN																					
COMPUTER MODELLING																					
DEVELOPMENT																					
STRESS/WEIGHTS																					
AERO/THERMO/HYDRODYNAMICS																					
STRUCTURES																					
SPECIFICATIONS																					
SOFTWARE DEVELOPMENT																					
SYSTEMS INTEGRATION																					
CONFIGURATION CONTROL																					
RISK ANALYSIS/MANAGEMENT																					
SAFETY/HAZARD ANALYSIS																					
INTERCHANGEABILITY																					
RELIABILITY																					
LOGISTICS ANALYSIS/SUPPORT																					
VALUE ANALYSIS/ENGINEERING																					
INSTRUMENTATION																					
TEST EQUIPMENT																					
ENVIRONMENTAL TESTING																					
TRIALS																					
PERFORMANCE ANALYSIS																					
REFERENCE EQUIPMENT																					
TECHNICAL PUBLICATIONS																					
SUPPORT TO PRODUCTION																					
JIG & TOOL DESIGN																					
TOTAL MANNING																					
CONTROL RATIOS	2	3	4	5	6	7													BOOKER : N-BOOK RATIO		

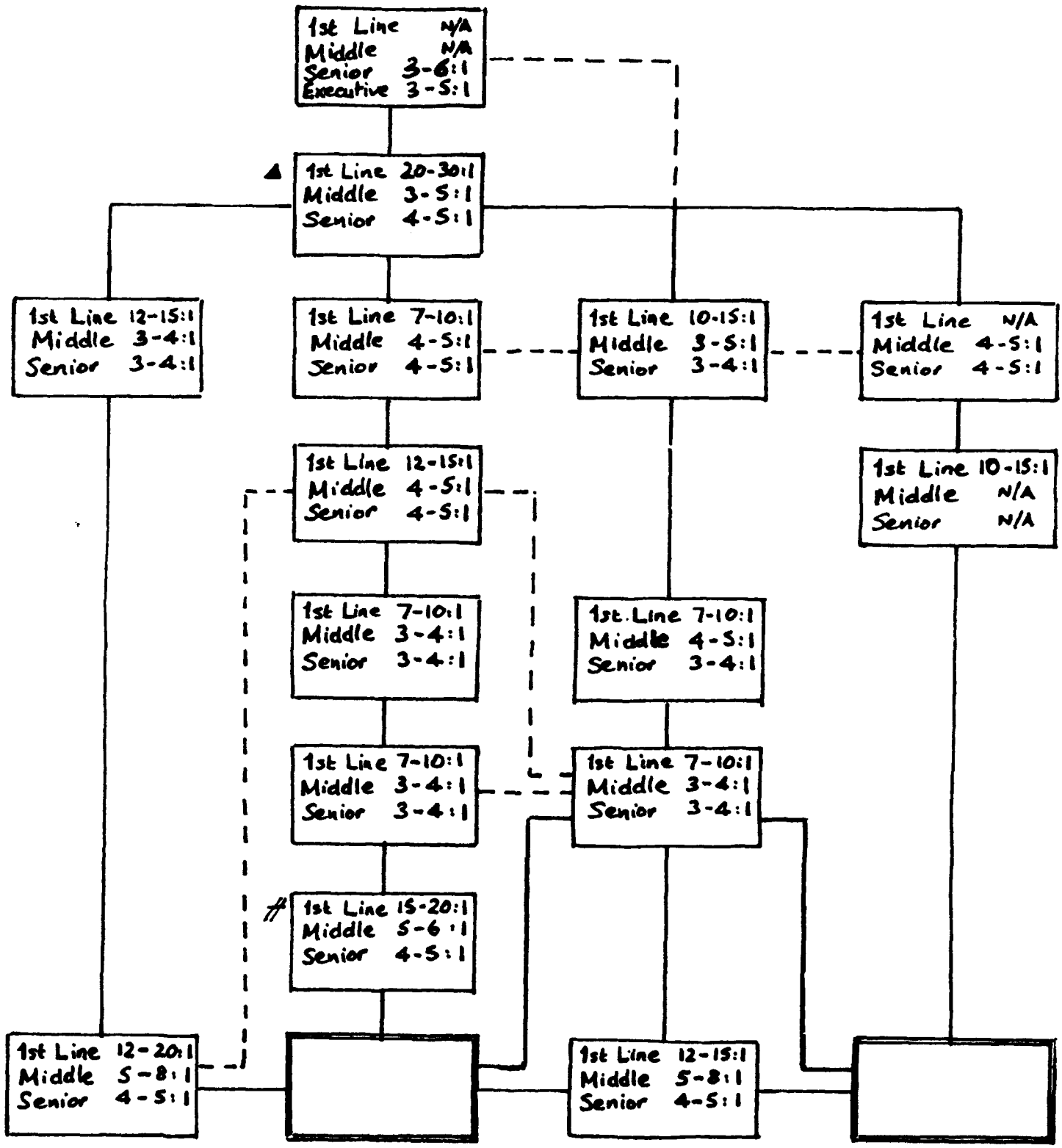
Typical Functional Manning Parametrics



TYPICAL SKILL MIX PARAMETRICS AT 1ST LINE



TYPICAL SPAN OF CONTROL PARAMETRICS



1st Line supervision covers productive labour and non-productive supporting staff.

A WORKED EXAMPLE

Stage 0

Determine the number of Workshop Productives = 1000

Stage 1 (for Stores & Transport)

Determine Functional Manning Parametric = 0.08 < 0.10 < 0.105
Function Manning = 1000 x 0.10 = 100

Stage 2

Determine Skill Mix Parametric = 25% Clerical, 75% Craft
Function Manning 25 Clerical
75 Craft

Stage 3

Determine Span of Control Parametric = 12 < 13 < 15
Function Manning 2 Clerical Supervision
23 Clerical
5 Craft Supervision
65 Craft

Determine Middle Management Span of Control Parametric
Changes Function Manning to:-
4 Craft Supervision
1 Middle Manager

Stage 4

Apply Employment Cost Rates and Materials additions, etc
Function Operating Cost

Labour costs	2 x	$A/year
	25 x	$B/year
	4 x	$C/year
	65 x	$D/year
	1 x	$E/year
Material costs		$F/year
Utilities costs		$G/year
Total		